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FIRE RESISTANCE OF BRICK WALLS

A preliminary report giving results of fire tests of brick walls, tested either restrained within rigid frames or unrestrained with full freedom for expansion and deflection at the top and sides, was published in The American Architect September 23 and October 10, 1923. While these tests gave important information on stability and temperature transmission as exposed to the standard test fire on one side for six hours, the ultimate resistance of walls thicker than 8 or 9 inches was not developed in this period; also, there remained the question of ability to support the loads for which walls are designed throughout the long fires required to develop the limiting permissible temperature rise on the unexposed side. Two panel frames for the large furnace, accommodating walls 16 feet wide and 10 to 11 feet high, were,

therefore, modified to permit application of loads up to 400,000 pounds during the fire exposure. Using these frames, typical wall constructions were subjected to fire tests under a load of 80 lbs./in.² for 4-inch walls and 160 lbs./in.² for walls of greater thickness. Further tests to determine the ultimate endurance periods for the thicker walls were made in a smaller furnace, as well as tests of plastered walls and some types of hollow walls not included in the original program. The concluding tests were of typical walls dried to constant weight at temperatures near 75° C. (167° F.), to determine the difference in temperature transmission as compared with that of walls which had been seasoned for the usual period of 40 to 50 days before testing. It was appreciated that all free water would not be given off in this time, and during the test evaporation of

this water retarded the temperature rise on the unexposed side of the wall. Therefore the rate of increase in temperature was less than would be the case for party and fire walls when exposed to fire after some years of service in the interior of heated buildings.

Pending publication of results of the tests, Letter Circular No. 228, giving a summary of testing methods and results with walls built of clay and shale bricks, has been prepared to supply information in response to individual requests.

The accompanying table gives the ultimate fire-resistance periods developed by clay or shale brick walls. In the walls designated as "solid" in the second column of the table the bricks were laid flatwise in common or running bond, with one header course for every five stretcher courses. In the hollow "rolok" walls the bricks were set on edge with alternate headers and stretchers, or with two rows of stretchers on edge alternating with one row of headers laid flatwise. In the "rolok-bak" design the bricks on one face of the wall were laid flat and for the rest of the wall on edge, one header course alternating with six stretcher courses in the face and four in the backing.

Efforts were made to secure ordinary commercial workmanship for both solid and hollow walls. The results in the table are based on the use of Portland cement or Portland cement-lime mortar 1:3 by volume, except for solid walls of resistance periods of six hours or less, for which 1:3 lime mortar can also be used.

Combustible members framed into the wall from the unexposed side generally reduce the fire resistance of the wall, since the time required to ignite their ends, assumed to project 4 inches into the wall, is generally less than that required for the limiting temperature rise on the unexposed side. The resistance of hollow walls can be increased by filling above, below, and between such members with brick and mortar to a depth of not less than 4 inches.

The fire-resistance periods in the last column of the table, in so far as they concern walls without combustible members projecting into them, are determined either by the length of time required to attain an average temperature rise of 139° C. (250° F.) on the unexposed side, the temperatures being measured according to present standards under asbestos pads 4/10 inch thick placed in contact with the wall surface or by failure under working load. For walls of clay and shale brick the latter occurred only after 10 hours of fire exposure with 12-inch walls built of bricks having low fusion point. All other walls carried the load for periods exceeding those determined by the temperature transmission, hence the fire-resistance period was governed by the latter.

It will be seen from the table that a considerable increase in fire resistance is obtained by plaster. The plasters used in the tests, on which the periods for plastered walls are based, were of neat gypsum or Portland cement mixed with three volume parts of sand. For the Portland cement plasters lime may be substituted for the cement in volumes up to 50 per cent of the cement.

The fire-resistance periods given are to be taken as the ultimate values for walls of the given type, construction details, and thickness. They are in this sense comparable with crushing-strength values obtained in compression tests. In applying constructions that have developed given fire-resistance periods to building conditions a factor of safety should be taken on the results of the tests to allow for variations in material and workmanship and other conditions that the tests did not fully account for. The use of factors from 1¼ to 1½ is advocated. In the case of the constructions tested the higher value does not appear to give a greater margin than necessary. On this basis a building condition that can produce a possible fire equivalent to the first two hours of the standard fire test would require a 3-hour wall and a 6-hour fire condition, a 9-hour wall.

Ultimate fire resistance periods of brick walls, bricks made of clay or shale

Nominal thickness	Type	Building members projecting into wall	Fire-resistance period
4-inch, unplastered.....	Solid.....	None or incombustible.....	Hours 1
4-inch, plastered, both sides.....	do.....	do.....	2½
8-inch, unplastered.....	do.....	do.....	5
8-inch, plastered, both sides.....	do.....	Combustible.....	2
	do.....	None or incombustible.....	9
	do.....	Combustible.....	4
12-inch, unplastered.....	do.....	None or incombustible.....	1 10
	do.....	Combustible.....	1 13
	do.....	Combustible.....	9
8-inch, unplastered.....	Hollow "Rolok".....	None or incombustible.....	2½
	do.....	Combustible; hollow spaces at floor line filled.....	2
8-inch, plastered both sides.....	do.....	None or incombustible.....	5
	do.....	Combustible; hollow spaces at floor line filled.....	4
	do.....	Combustible (from one side only); hollow spaces at floor line not filled.....	2½
12-inch, unplastered.....	do.....	None or incombustible.....	5
	do.....	Combustible; hollow spaces at floor lines filled.....	5
	do.....	Combustible (from one side only); hollow spaces at floor line not filled.....	3½
12-inch, plastered both sides.....	do.....	None or incombustible.....	9
	do.....	Combustible; hollow spaces at floor line filled.....	9
	do.....	Combustible (from one side only); hollow spaces at floor line not filled.....	6
8-inch, brick-faced, plastered back side.....	Hollow "Rolok-bak".....	None or incombustible.....	5
	do.....	Combustible; hollow spaces at floor line filled.....	4
	do.....	Combustible; hollow spaces at floor lines not filled.....	2½
12-inch brick-faced, unplastered.....	do.....	None or incombustible.....	1 10
	do.....	Combustible; hollow spaces at floor lines filled.....	1 9
	do.....	Combustible; hollow spaces at floor lines not filled.....	6

¹ Determined by load-carrying ability.² Determined by temperature transmission only.**SAFE CONSTRUCTION OF OVERHEAD ELECTRICAL LINES**

The Bureau of Standards, Department of Commerce, has for many years been engaged upon an investigation of accidents occurring in the electrical industry and of methods of construction and installation which would obviate the hazards connected with this work. The result of the investigation is represented in part by a publication known as the National Electrical Safety Code, which is now in its fourth edition and which contains rules based upon experience and extensive study, which by general application will, it is hoped, reduce the casualties which have been associated in the past with the utilization of this very useful but to some extent hazardous agency.

The code is divided into five parts dealing with different branches of the subject. The part dealing with the construction and maintenance of electrical supply and communication lines has just been issued by the bureau as Handbook No. 10. It contains engineering standards for the construction of pole and tower lines, including their strength; the arrangement of wires; the proper clearances between conductors and between conductors and their supports; and all the various details that go into the erection and maintenance of such overhead lines.

With respect to strength of construction, the country is divided into three districts, chosen with respect to the severity of the weather experienced, because it is the presence of sleet and high

winds that results in the occasional failure of such lines. The strength of construction is consequently separately specified for each of the three districts.

The proper sizes and stringing sags for conductors are also given consideration, and extensive tables tell the lineman the proper sags to give to the conductors when strung for different conditions of material, temperature, geographic location, and size of conductor.

The safety of the lineman who must work upon poles carrying live conductors is covered by providing suitable climbing space and working space upon the pole structure between the wires. In addition to these items of construction, there are operating rules which prescribe the use of safety belts, insulating protectors, and other devices to further obviate the hazards which might otherwise exist.

The rules refer not only to power lines, but to telephone, telegraph, and other circuits used for signaling or for communication purposes. The relative levels at which the different classes of wires should be run, the joint use of poles by the different classes of circuits, the avoidance of conflict between different pole lines, and all of the many details which must be considered in carrying out this work are covered in the code.

The rules relating to the construction and maintenance of overhead lines are published in Handbook No. 10 of the Bureau of Standards, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 60 cents per copy. Rules relating to radio equipment, to powerhouses, and to utilization of electrical energy are contained in other publications.

BUILDING CONTRACTS DURING JUNE

Building-construction contracts awarded, as reported by the F. W. Dodge Corporation, for 36 Eastern States in June, 1927, were valued at \$612,113,000, the highest monthly total ever reported. This is an increase of 17 per cent over

June, 1926, and brings the total for the first half of 1927, 2 per cent over the comparative total for the first half of 1926.

The distribution of the contracts by classes of construction for June is not yet available. The awards by districts show a more uniform distribution of activity than prevailed earlier in the year, with the Central West and Middle Atlantic districts showing pronounced heavy awards in June.

Construction costs show little change from the levels of early months, with a tendency for building-material prices to slowly decline, offset probably by increases in wage rates.

BETTER HOMES IN AMERICA

The chief of the division of building and housing acted as a member of the committee on awards in selecting prize winners in the 1927 Better Homes in America campaign. More than 3,700 chairmen undertook to organize local demonstrations, and the reports received thus far indicate distinct advances over previous years in the design, furnishing, and equipment of moderate-priced houses. There was, as before, special emphasis on seeing what could be accomplished within the financial resources of the family in average or lower circumstances.

METAL LATH

The producers of metal lath met at the Department of Commerce on June 17 in an annual revision conference. A committee was appointed to investigate the standardization of weights of the $\frac{3}{4}$ -rib lath with a view of reaching unanimity on three varieties. Certain varieties in the flat expanded metal lath, the $\frac{5}{8}$ -rib expanded lath, and the flat rib expanded lath were adopted as standard, with others noted as specials. It was the unanimous opinion of the conference that the industry should make every effort to eliminate these "specials" during the ensuing year. An additional variety, 2.50, was added to the painted $\frac{3}{8}$ -rib expanded lath. The conference reaffirmed the recommendations of pre-

vious conferences for painted steel sheet lath to weigh not less than 4.5 pounds per square yard, with corresponding minimum weights in this type of lath made from special metals or from sheets galvanized before fabrication. Metal lath in all types and weights galvanized after fabrication is to be eliminated, all types of lath are to be specified and sold by weight per square yard. The provisions of the revision of the recommendation became effective July 1, 1927.

ODD LENGTHS OF LUMBER

In an effort to utilize sawlogs to the fullest extent the wood utilization committee of the division of simplified practice has decided to start a project during the next 12 months involving the marketing of so-called odd lengths. Heretofore softwood lumber in particular has been cut in even lengths, such as 8, 10, 12, 14, and 16 feet, etc. Because of habit and apparently for no good reason, the intermediary odd lengths, such as 9, 11, 13, 15, and 17 feet, etc., have not been produced. A preliminary investigation conducted by the committee revealed the fact that there is evidently just as good a demand for these odd lengths. In fact, the absence on the market of odd lengths has been a handicap, particularly to the building industry.

REACTION OF WATER ON THE CALCIUM ALUMINATES

Investigations¹ have shown that lime can combine with alumina only in the following molecular proportions: $3\text{CaO} \cdot 5\text{Al}_2\text{O}_3$, $\text{CaO} \cdot \text{Al}_2\text{O}_3$, $5\text{CaO} \cdot 3\text{Al}_2\text{O}_3$, $3\text{CaO} \cdot \text{Al}_2\text{O}_3$. Tricalcium aluminate appears to be the only aluminate present in Portland cement of normal composition and normal properties. The monocalcium aluminate and the 3:5 calcium aluminate occur in cements characterized by a high alumina content. The cementing qualities of the calcium aluminates has been reported in Bureau of Standards Technologic Paper No. 197, and the hydration of Portland cement in Bureau of Standards Technologic Paper No. 43.

An investigation has been undertaken at the bureau to obtain more information on the mechanism of the reaction of water on the calcium aluminates. Some preliminary experiments had indicated that the cementing qualities of the calcium aluminates and high alumina cements might be closely related to their reaction with water in the formation of metastable or supersaturated solutions of calcium aluminates. It was decided, therefore, to study not only the chemical composition and pH of these solutions as they were formed in the early periods of the setting processes, but also to follow the changes which they underwent in passing from a metastable condition to one of equilibrium. Since the addition of water to freshly prepared tricalcium aluminate, $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, produces a very vigorous reaction, the changes in composition of the resulting solutions could not be followed in the case of this aluminate. Previous investigations have indicated that its setting is due to the formation of hydrated tricalcium aluminate.

The procedure adopted for the other calcium aluminates and a high alumina cement was to shake 50 grams of the anhydrous material for each liter of water for a given time and to filter the mixture rapidly. Samples of this filtrate were taken at once for a chemical analysis and a pH determination. The solutions obtained in the early periods of the setting processes showed an increase in the total lime and alumina with increased time of shaking until a maximum was reached. Further shaking resulted in a rapid decrease, which in turn became less as time went on. An apparent state of equilibrium was reached only after several weeks had elapsed. It was surprising to find that these anhydrous calcium aluminates, differing so widely in chemical composition, reacted with water in the early periods of the setting processes to form calcium aluminate solutions with the molar ratio of $\text{CaO}/\text{Al}_2\text{O}_3$ in each case very close to

¹ Rankin, The ternary system lime-alumina silica, *Am. J. Sci.*, **30**; January, 1915.

1.1. The pH of these solutions was close to 11.2. At the later periods the molar ratio of $\text{CaO}/\text{Al}_2\text{O}_3$ in solution had increased with an increase in the pH.

Identical changes in the metastable solutions took place when filtered from the reaction mixture. Part of the lime and alumina precipitated from these clear solutions leaving an equilibrium solution similar to that obtained when the aluminates had been left in contact with the water for long periods. The molar ratio of lime to alumina in solution increased. This was accompanied by an increase in pH to about 11.75. Chemical analysis and petrographic examination of the material precipitated from the metastable solutions indicated that hydrated alumina and hydrated tricalcium aluminate were precipitated as equilibrium was approached. Calculations based upon electrometric measurements indicate that the aluminate in solution is the calcium salt of monobasic aluminic acid.

It would appear that the cementing properties of the monocalcium aluminate, the 3 : 5 calcium aluminate, the 5 : 3 calcium aluminate, and the high alumina cement studied were in part due to the precipitation of hydrated alumina and crystalline hydrated tricalcium aluminate and a metastable and supersaturated monocalcium aluminate solution.

EXPANSION OF CALCINED GYPSUM DURING SETTING

The expansion which occurs when calcined gypsum sets is one of its important properties. This property makes gypsum an excellent material for casting purposes, as it enables the material to give true reproductions of the mold. In some other uses this expansion is undesirable and is to be avoided if possible.

An investigation has been conducted at the bureau to determine whether it is possible by simple methods to control this expansion. It was found that the expansion might be controlled within certain limits by control of the ingre-

dients of plasters and of the conditions under which they are used.

An increase in the proportion of mixing water decreased the expansion. Using a given proportion of water, finely ground gypsum expanded much more than coarsely ground gypsum. With sand as an aggregate, an increase in the proportion of sand decreased the expansion, while a mix made with coarse sand expanded less than one with fine sand when the amounts of sand used were the same.

Retardation of the setting time had little effect on the final expansion but caused an initial contraction, so that the final volume was less than that obtained with unretarded materials. Evaporation increased this effect.

Variations in the time and temperature of calcination were tried, but these produced little differences in the expansion on setting. The use of certain admixtures decreased the expansion to a marked extent.

A report has been prepared giving in detail the results obtained. Announcement of publication will be made in the usual way in a future issue of the Technical News Bulletin.

STANDARDS YEARBOOK FOR 1928

Letters have been sent to officers in all the States requesting information concerning lists of officers of municipalities, so that information can be obtained on purchasing methods. This will be used in connection with the certification plan of purchasing and in the preparation of the 1928 Standards Yearbook.

Form letters are also being sent to all trade associations and technical societies interested in standards, specifications, grading rules, codes, etc., requesting information concerning their standardization work. The replies to these letters will also be used as the basis for data in the yearbook. Steps have been taken to obtain information on the activities and accomplishments of national standardizing associations in 20 foreign countries.

THIRD INTERNATIONAL CONGRESS ON SCIENTIFIC MANAGEMENT

A cordial invitation has been extended to American engineers and industrialists to attend this congress, which will convene in Rome on Monday, September 5, to discuss four classes of problems, to wit:

1. Scientific organization of labor in the manufacture of industrial products.
2. Scientific organization of labor in agriculture and in transportation of products of the soil.
3. Scientific organization of labor in public and public utility services.
4. Scientific organization of labor for domestic economy.

A large part of the program will be furnished by Americans. The cordiality of the invitation and the active interest and leadership of Signor Mussolini and of many of the foremost engineers not only of Italy but of all Europe insure the character of the congress. Those who may find it possible to attend can obtain complete information from Dr. H. S. Person, secretary of the committee on American participation in international management congress, Room 611, 29 West Thirty-ninth Street, New York, N. Y. Ray M. Hudson, chief of the division of simplified practice, Department of Commerce, who is also secretary of the national management week for 1927, has been asked to prepare two papers for presentation before the congress—one on "Simplified practice," using the paving-brick simplification as a typical case, and the other on "Management week in the United States."

MANAGEMENT WEEK, 1927

Interest in the plans and program for Management Week, October 24 to 29, 1927, is steadily growing. To date local organizers have been selected in over 50 cities and local committees have been appointed in Utica and Rochester, N. Y.; Columbus and Dayton, Ohio; Jackson, Mich.; and Elizabeth, N. J. In Indiana Prof. George H. Shepard, of Purdue University, is organizing a program cover-

ing practically the entire State outside of Indianapolis. The Dayton (Ohio) program covers several of the near-by industrial towns of the Miami Valley.

The national committee at its meeting in New York, June 17, approved the progress made and instructed the secretary to write the International Management Institute at Geneva, Switzerland, in an endeavor to make Management Week an international event. This subject is likely to come up for discussion at the Third International Management Congress in Rome next September.

Meantime the 10 sponsor organizations in the United States are urging their members to cooperate with the local committee in their home communities in making the 1927 program a nation-wide success. It is expected that this year's record will surpass that of last year with its 252 meetings, attended by over 30,000 executives and others interested in management.

Since management engineering, according to the American Society of Mechanical Engineers, relates to "the coordination in industry of the functions of finance, purchasing, production, sales, and distribution," all readers of this Bulletin who have an interest in any of these phases of modern business are cordially invited to participate through the local committee where the reader resides. For further particulars regarding local programs, etc., address R. M. Hudson, secretary of the national committee on management week, care division of simplified practice, Department of Commerce, Washington, D. C.

HOSPITAL PLUMBING FIXTURES

At the second preliminary conference called at the suggestion of the committee on standardization and simplification of the American Hospital Association, held in New York City on June 2, representatives of the vitreous china industry, the porcelain plumbing fixtures manufacturers, and the hospital field were present. It was the sense of the meeting that a survey be made to determine the

sales of basic fixtures for 1926. After the result of this survey has been analyzed by the manufacturers they will meet with the Department of Commerce in order to determine what they may consider the appropriate simplified list to be submitted to the hospital authorities for criticism and comment. After the hospital group has compiled its criticisms and comments there will be a joint meeting of manufacturers and the hospital committee to concur in a final recommendation to be made to the division of simplified practice for discussion and approval at a final conference of all interests.

HOSPITAL AND INSTITUTIONAL TEXTILES

Manufacturers, distributors, and users of hospital and other institutional textiles met at the Department of Commerce on June 10, at which time a simplified practice recommendation was developed eliminating a large variety of sizes of bed pads, pillowcases, sheets, spreads, scarfs, towels, etc. The recommendation is now before the industry for acceptance.

CONFERENCE ON CAST IRON FOR ENAMELING PURPOSES

Since the preceding item concerning this investigation appeared in this Bulletin (No. 120, April, 1927), a meeting has been held of representatives of the American Ceramic Society, which is co-operating with the bureau in this work, with representatives of the ceramics and metallurgy divisions of the bureau. The significance of the more recent results which had been obtained was discussed, and with these results as a basis a program of work, subject to modification as need arises, was agreed upon.

It was decided that the method of test which has been recently developed at the bureau, reference to which was made in the preceding news item on this subject, would serve best to bring out any definite and consistent difference in the tendencies of two irons to cause blisters. The method consists of applying enamel to each iron under a variety

of conditions instead of a single standard condition and distinguishing between irons according to the magnitude of the range of conditions under which each will produce blister-free ware. It was further agreed that two irons which had in the past shown wide differences in the magnitude of their enameling ranges should be made up in large quantities for extensive tests both at the bureau and in the laboratories of two commercial organizations. These tests include a comparison of the relative behavior of the two irons when coated with different types of enamels and fired in different types and sizes of furnaces.

The execution of the program outlined at the meeting is now in progress. The casting of 1,400 specimens has been completed, and ranges of enameling treatment which appear satisfactory for regular use have been worked out for two types of enamels and two types of furnaces.

STUDY OF EXTRUSION MACHINES—EFFECT OF VARIOUS AUGER TIPS, COLLECTIVE SPACERS, AND DIES

Pursuant to an item on this subject published in the April, 1927, Technical News Bulletin (No. 120), the following supplementary information has been obtained:

It appears that the type of auger tip and the length of the collective spacer between the tip of the auger and the mouth of the die have each a decidedly greater effect on the output and quality of the ware than does either the length or the taper of the brick die. Slight changes in the moisture content of the material in the vicinity of the point of optimum plasticity has even a greater effect on the power consumption than either the type of auger or the length of the collective spacer.

The same kind of clay that was used in the brick-die investigation and described in the November, 1926, Technical News Bulletin (No. 115) has been used in the study of hollow-tile dies and equipment. So far only single, double, and triple winged augers, 6 to 24 inch length spacers in 2-inch increments, and a two-cell hollow-tile die have been used.

It has developed in this study, as in the previous work on brick dies, that the single-winged auger is the most efficient of the three types, both as regards output per unit of power and quality of the ware, for a medium plastic clay. The column speed when using a single-winged auger is about 100 per cent greater than for a double-winged auger and 10 to 15 per cent greater than for a triple-winged auger. Longer collective spacers are required for hollow-tile dies than for brick dies in order to overcome the column defects produced by an uneven pressure back of the cores.

TRANSMISSION OF VITALIZING OR ACTIVATING RAYS THROUGH GLASS

It is well known to the medical profession that ordinary window glass absorbs the short-wave length ultra-violet solar rays which have the property of preventing rickets. In order to anticipate the question that would arise regarding the total amount of these activating rays in sunlight, especially at sea level, measurements were made at the noon hour during April, May, and June of the total amount of these activating rays shut out by ordinary window glass and by the newer glasses and glass substitutes now being marketed.

Starting with ordinary window glass as entirely opaque to the so-called "vitalizing or activating rays," the transmission in this spectral region of the average substitute materials now being marketed ranges from less than 5 to 50 per cent and even reaches 92 per cent for the best grades, including pure quartz glass. The amount of these vitalizing rays is about 4 per cent of the total incoming solar rays, or about 0.04 to 0.05 gram calory per square centimeter per minute.

As to the actual effect upon health of using materials which transmit a high percentage of these short waves, the bureau can not make any statement, since such questions are entirely outside the bureau's field.

ULTRA-VIOLET TRANSMISSION OF CELANESE

The bureau has received numerous inquiries as to the ultra-violet transmission characteristics of celanese.

Qualitative tests by the radiometry section show that uncolored cloth of satin weave transmits but little ultra-violet light of wave lengths less than 303μ . The blue-colored voile weave readily transmits these rays. Folding the voile-weave cloth so that the light had to pass through four layers of the material greatly reduced the transmission, absorbing practically all the "vitalizing rays."

Evidently the closeness of the weave determines the amount of ultra-violet transmission. Wetting the satin weave did not appreciably increase the transmission.

ANALYSIS OF THE ARC AND SPARK SPECTRA OF SCANDIUM

The chief of the bureau's spectroscopy section recently completed an extensive description of the spectral lines which characterize neutral and ionized atoms of scandium. In cooperation with Professor Russell, of Princeton, an analysis of these spectra has been completed, which classifies nearly all of the observed lines—350 of Sc I and 142 of Sc II. The atom of scandium normally has 21 outer electrons, but 18 of these are in closed stable groups which play no part in the chemical valency or the optical spectrum. The Sc I spectrum is thus a typical 3-electron spectrum in which, according to the alternation law, the energy states are double or quadruple, and the Sc II spectrum, which is characteristic of scandium atoms with one electron removed, is described by singlet and triplet states or spectral terms. The various terms in each case are ascribed to specific configurations of the electrons as indicated by recent developments in the quantum theory of spectra, and the observed structures of Sc I and Sc II spectra are found to be in complete agreement with the theory. Terms belonging to so-called spectral series have

been detected in both spectra; these point to the energy which is required to remove one of the outer electrons. The outermost electron (twenty-first) of scandium can be removed by impact of a free electron which has acquired a certain velocity by falling through a potential difference of 6.7 volts, and the atom can be robbed of another electron (twentieth) by colliding with a free electron which has acquired energy of motion by falling through a potential difference of 12.8 volts. These facts are of special importance in the interpretation of the spectrum of the sun.

This work is fully described in Bureau of Standards Scientific Paper No. 549, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

DENTAL RESEARCH PROGRESS REPORT

The annual progress report on the program of dental research being conducted at the bureau in cooperation with the Weinstein Laboratories is being prepared. It is expected that this report will be ready for publication in October. Further announcement regarding the exact date of publication will be given later.

This report will give data on the alloys used in casting dental restorations and will supply details for the preparation of samples sufficiently reliable for use in a research on these materials. It is expected that this report will enable the profession to arrive at a better understanding of what is essential for satisfactory materials to be used in the various types of cast restorations now being supplied in their practice.

Previous reports have stimulated interest in the importance of the physical properties of dental materials, and already the bureau has noticed a tendency for the various organizations interested in dental materials to devote a more intensive study to this type of research. Letters expressing approval of the work and making inquiry regarding details of tests prove the genuine inter-

est in such work. The bureau feels sure that within the next two years the dental college laboratories will be able, as a result of this work, to rate or verify materials and to publish their findings in a more conclusive manner than has been possible in the past, all of which will mean more efficient dental service to the public.

MAIL BAG DUCK

A survey of the mail bags coming to the mail-equipment shops of the Post Office Department for repair showed that an increasingly large number was being received, and that the breaks and tears were occurring across the filling direction. The duck from which the bags are made is woven, under Executive order, by the Atlanta prison mill.

At a conference of representatives of the Post Office Department, Department of Justice, Bureau of the Budget, and Bureau of Standards the last named undertook a study of the present duck construction with a view toward improvement.

A number of constructions were made with different plies and thread counts. Consideration of the results of tests on these experimental fabrics resulted in a selection of one construction which should prove satisfactory for mail bags, and specifications have been based on this. Some materials woven to meet these specifications have appeared very satisfactory, judging by laboratory tests. The Post Office Department is planning to obtain service data during the next year or two.

USE OF CELITE IN RUBBER COMPOUNDS

The Celite Co. has established a fellowship at the bureau to investigate the properties which the various grades of Celite impart to vulcanized compounded rubber.

Both the bureau and the Celite Co. have previously studied the use of various forms of diatomaceous silica as a filler in rubber goods, but it is the purpose of the present fellowship to investigate the subject much more intensively

than before and also to extend it to include the finest materials that can be made from diatomaceous silica by grinding in various types of mills and other means of disintegration.

CAROÁ FIBER AS A PAPER-MAKING MATERIAL

The fiber content of many grades of papers, such as book, newsprint, and the cheaper writings, is obtained almost exclusively from wood pulp. But for fine papers in which unusual strength is required—ledgers, bonds, currency—rags are commonly used, and for strong bag or wrapping paper, in which strength is more important than color, worn and salvaged rags, old rope, and waste tow are generally utilized. There is, however, a scarcity of rag and rope stock available for paper making and the problem of finding new fibers possessing the essential characteristics of these materials is receiving attention. Recent experimental tests at the bureau have shown the fiber of the caroá plant to be a very satisfactory paper-making material and suitable for use with or as a substitute for rag and rope stock in paper production.

Caroá is a plant of the pineapple family and is indigenous to eastern Brazil. The leaf of the plant is about 4 feet long and from $1\frac{1}{2}$ to 2 inches wide, being slightly larger than that of the pineapple, which in certain parts of the world, particularly the Philippine Islands, is extensively used for the manufacture of textiles. By beating the leaf between stones the natives separate the fiber, which, after subsequent retting and washing, is used locally for coarse, handmade twines, nets, and rope. Caroá is not recommended for the commercial manufacture of cordage, however, because the fibers, although strong and resistant, are too hard and do not clean easily. The pulpy residue which remains after cleaning rapidly ferments and decomposes in the presence of moisture.

There is at present no organized caroá industry. Available production and cost estimates are somewhat meager, but indicate that if there were sufficient demand

for the fiber a supply of considerable quantity could be procured at a cost which would permit the use of the material for paper-making purposes.

Three samples of caroá, each having received different treatment in the separation of the fiber previous to shipment, were employed in the paper-making tests. The tests, which are described in detail in Bureau of Standards Technologic Paper No. 340, were made on both laboratory and semicommercial basis.

The laboratory equipment employed in the preparation of the pulp and its subsequent conversion into paper consisted of a small cylindrical rotary boiler, $\frac{1}{2}$ -pound beater, fiber sheet mold, sheet press, and drier. The fiber sheet mold and sheet press were designed and constructed at the bureau for making small sheets of fiber in laboratory-scale paper-making research and have proved very satisfactory in the production of small sheets of uniform quality (weight, formation, etc.).

For commercial interpretation and comparison tests were also made in the experimental paper mill of the bureau. The mill is equipped for making paper on a semicommercial scale under practical mill conditions. The equipment employed in the caroá investigation consisted of a rag duster, rag cutter, rotary boiler, 50-pound copper-lined wood tub beater with manganese-bronze bars and plate and fitted with a washing cylinder, small Jordan with iron bars, a 4-plate screen, and a 29-inch Fourdrinier paper-making machine. The procedure followed in the mill tests was essentially the same as that generally observed in the commercial production of high-grade papers.

A number of cooks were made by the caustic-soda process and one by the lime process. Both writing and unbleached papers were produced in the subsequent paper-machine runs. The measurements of the finished paper were on samples conditioned in a constant temperature and constant humidity room (temperature 70° F., relative humidity 65 per cent). Similar tests on high-

grade rag, sulphite, and kraft pulps were included for comparison.

The test data show the caroá fiber to be a very satisfactory paper-making material on the basis of both quality of pulp produced and yield obtained.

When cooked by the caustic-soda process, with the smaller amounts of caustic, caroá produces paper which is excellent for bag or wrapping purposes and is as strong as that made from kraft pulp; with the larger amounts of caustic the pulp is stronger than sulphite and compares favorably with rag.

The treatment of the plant in the separation of the fiber for transportation is an important factor in determining the characteristics of the paper made therefrom. For the fibrous material separated by mechanical processes the yield is low (40 to 45 per cent), and bleaching the pulp is not practical, but the paper made therefrom shows unusual strength. Material obtained by retting gives a good yield of pulp (50 to 60 per cent), which bleaches easily and produces a strong paper (bursting strength about a point per pound at standard basic weight—pounds per 500 sheets 25 by 40 inches), although of less strength than that made from the fiber obtained by mechanical separation only.

A microscopic study of the structural composition of caroá shows the fiber to be cylindrical and comparatively long and of small diameter. These properties tend to produce good felting of fibers in paper making and give compactness and strength to the resulting sheet.

CURING CALFSKINS

The bureau has been requested by the Calf Tanners Association to cooperate with them in the development of standards for curing calfskins. There appears to be a large economic waste because of improper methods now in use, and it is predicted that the value of the skins to the collectors would be considerably greater with uniformity in curing. The use of old salt, rock salt, impure

salt, and the application of the salt too late after the animal is killed all lessen the value of the skin to the dealer and the tanner as well. Domestic calfskins, as a general rule, quite often are badly stained, the stains interfering with the production of the light-colored leathers now so popular.

As a first step in this work it has been decided to draft a specification for the salt which is suitable for use in curing skins. The collection of samples from various sources is now in progress. The chemical properties of the various samples will be determined in order to secure limits for use in the specification. Tanners, hide dealers, and salt dealers interested in this work may address the Bureau of Standards if further information is desired.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1926)

Scientific Papers ²

- S551. Absorption spectra of iron, cobalt, and nickel; W. F. Meggers and F. M. Walters, jr. Price, 10 cents.
S553. Further radiometric measurements and temperature estimates of the planet Mars, 1926; W. W. Coblentz and C. O. Lampland. Price, 15 cents.

Technologic Papers ²

- T340. Caroá fiber as a paper-making material; Merle B. Shaw and George W. Bicking. Price, 25 cents.
T341. A portable apparatus for transverse tests of brick; A. H. Stang. Price, 5 cents.
T342. Aging of soft-rubber goods; R. F. Tener, W. H. Smith, and W. L. Holt. Price, 15 cents.

² Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico); 40 cents (foreign).

Circulars²

C328. Testing of measuring tapes at the Bureau of Standards. Price, 10 cents.

C329. Calibration of a divided scale. Price, 10 cents.

C332. Testing of line standards of length. Price, 10 cents.

United States Government Master Specification for:

C115 (3d ed.). Pneumatic and solid rubber tires, and inner tubes. Price, 5 cents.

C239 (2d ed.). Flax packing. Price, 5 cents.

C241 (2d ed.). Compressed packing asbestos sheet. Price, 5 cents.

C242 (2d ed.). Asbestos metallic cloth gaskets. Price, 5 cents.

C243 (2d ed.). Asbestos metallic cloth sheet packing. Price, 5 cents.

C256 (2d ed.). Brown denim (shrunk). Price, 5 cents.

C334. Asbestos wick and rope packings. Price, 5 cents.

Simplified Practice Recommendation²

(Elimination of Waste)

R18 (1st rev.). Builders' hardware. Price, 10 cents.

Technical News Bulletin²

TNB:24. Technical News Bulletin, August, 1927.

OUTSIDE PUBLICATIONS²

Recent developments and applications of the electric telemeter. O. S. Peters; Paper presented at the thirtieth annual meeting, American Society for Testing Materials (1315 Spruce Street, Philadelphia, Pa.); June 20 to 24, 1927.

Starting ability of fuels compared.

Lean explosive limits for cracked and straight-run gasolines and other motor fuels. D. C. Ritchie; Journal Society of Automotive Engineers (29 West Thirty-ninth Street, New York, N. Y.); Vol. XXI, No. 1, p. 15; July, 1927.

Conditions of flow into the vertical capillary tube of the Saybolt thermoviscosimeter. W. H. Herschel; Industrial and Engineering Chemistry (Washington, D. C.); Vol. 19, No. 7, p. 837; July, 1927.

Friction of aviation engines. S. W. Sparrow and M. A. Thorne, Technical Report No. 262 of National Advisory Committee for Aeronautics (Washington, D. C.); July, 1927.

Data on the assay of rolled gold plate. Raleigh Gilchrist; Industrial and Engineering Chemistry (Washington, D. C.); Vol. 19, No. 7, p. 827; July, 1927.

III. Progress report on investigation of sagger clays; Their elasticity and transverse strength at several temperatures. R. A. Heindl and W. L. Pendergast; Journal of the American Ceramic Society (Columbus, Ohio); Vol. 10, No. 7, p. 524; July, 1927.

Testing standards of mass. A. T. Pienkowsky; The Monthly Review, official publication of Incorporated Society of Inspectors of Weights and Measures (Birmingham, England); Vol. XXXV, No. 6, p. 157; June, 1927.

² Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, and Mexico); 40 cents (foreign).

² "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

